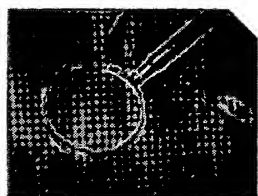


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## Metal forming glossary - C

**Numeric | A | B | C | D | E | F | G | H | I | J | K  
L | M | N | O | P | Q | R | S | T | U | V | W | XYZ**

### CAD

Acronym for Computer Aided Design.

### CAM

Acronym for Computer Aided Manufacturing.

### Cam

A device to move or do work at an angle to the press stroke. See cam slide or specific cams: aerial cam, dwelt cam, incline cam, shimmy cam, straight cam, and box cam.

### Cam action

A motion at an angle to the direction of an applied force achieved by a wedge or cam.

### Cam chart

A chart created by the tool designer assuring that the sequence of operations of a complicated part fall within the 360° slide forming machine cycle.

### Cam driver

A block with one or more angular surfaces that applies force by the vertical movement of the press to mating angular surfaces on a cam slide. Also called driver.

### Cam press

A mechanical press in which one or more of the slides are operated by cams; usually a double-action press in which the blank holder slide is operated by cams through which the dwelt is obtained.

### Cam slide

A device to perform work at an angle to the press stroke. Most common angle is 90°. Also called cam or slide.

### Cam trim

Removing excess material after the part has been drawn or formed. This is done with a cam activated operation, usually

as a secondary operation.

### **Camber**

Gradual deviation from straightness of the edge of sheet or coil stock caused during the slitting operation.

### **Camber tolerances**

Camber is the deviation from edge straightness. ASTM Standards define the maximum allowable tolerance of this deviation of a side edge from a straight line.

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### **Camera shutter steel**

Hardened, tempered and bright polished extra flat and extra precision rolled. Carbon content is 1.25 with Chromium content at 0.15.

### **Canning**

A dished distortion in a flat or nearly flat sheet metal surface, sometimes referred to as oil canning. Enclosing a highly reactive metal within a relatively inert material for the purpose of hot working without undue oxidation of the active metal.

### **Capital cost: Units**

The capital cost is the total cost of the equipment required to perform the process. Manual processes have lower capital costs than automated processes. In cost estimation, the capital cost is converted to a time-cost by dividing it by the capital write-off time, except when the equipment is totally dedicated to a single product. Then, it is calculated in the same way as tooling cost.

### **Carbon steel**

A steel that owes its specific properties chiefly to the presence of carbon, without substantial amounts of other alloying elements. It is also referred to as ordinary steel, straight carbon steel, or plain carbon steel.

### **Carburr**

A small carbide mill cutter usually one-half inch or less in diameter. Designed to remove stock from hardened tool steel.

### **Carrier strip**

The area of a stock strip that ties the parts together and carries them through a progressive die until the final operation.

### **Case**

The surface layer or case of a ferrous alloy that has been made substantially harder than the interior or core.

**Case hardening**

Any process of hardening a ferrous alloy so that the case or surface is substantially harder than the core or interior.

[top](#) ▲**Center**

The point that is defined midway between the extents of a hole in both the X and Y directions.

**Center buckle**

A condition in a band of steel where the center (in the direction of rolling) is longer than the edges and has a wave or buckle.

**Center drill**

A combined drill and countersink. The countersink is 60° included angle. Primarily used to drill center holes in the end of parts on the lathe and spotting centers of holes to be drilled.

**Center tool**

See mandrel.

**C-frame press**

A press having uprights or housing resembling the letter "C". Also called gap frame or overhanging press.

**Chain dimensioning**

A drafting practice which dimensions repetitive features from each other.

**Chain slots**

Machined or cast slots in the upper and lower die shoe and large adapters for handling purposes.

**Chair**

A precision ground block, which has a slot or hole on one surface and a leg off the opposite surface from the slot or hole. One surface of the leg is on the center line of the slot or hole. Used with an indicator to find the exact edge of a surface.

**Chamfer**

A beveled surface to eliminate an otherwise sharp corner that is typically about a 45° angle. A relieved angular cutting edge at a tooth corner.

[top](#) ▲**Checks**

Surface ripples and cracks induced by forming.

**Chemistries**

The chemical composition of steel indicating the amount of carbon, manganese, sulfur, phosphorous and a host of other elements.

**Chicago screw**

A socket head cap screw with the head and the upper portion of the body turned down, leaving a minimum number of threads on the end of the body. Used where the screw hole in the detail does not align with the threaded hole in the mounting surface. Also called Eberly screws, rubber screws, or Kelly screws.

**Chopoff**

See cutoff.

**Chord modulus**

The slope of the chord drawn between any two specific points on a stress-strain curve. See also modulus of elasticity.

**Chromium-nickel steel**

steel usually made by the electric furnace process in which chromium and nickel participate as alloying elements. The stainless steel of 18% chromium and 8% nickel are the better known of the chromium-nickel types.

**Chute**

A trough in which blanks, workpieces, scrap, or parts are fed to or conveyed away from a die or press.

**Circle**

A continuous arc starting and ending at the same point.

**Circle grid**

A regular pattern of circles, [2.5 mm (0.1 in.) diameter], marked on a sheet metal blank.

**Circle grid analysis**

A technique of measuring strains on deformed sheet steel. The result can then be plotted on the forming limit diagram.

**Clad shape**

A roll formed shape made up of two materials simultaneously fed into the roll forming mill to produce a composite section.

**Clamp marks**

These are slight indentations at the edge of one side of metal stock caused by pressure from turret press holding devices.

**Class 1 surface quality steel**

A class of cold rolled steel processed to meet requirements for controlled surface texture, flatness, and temper requirements. This steel is commonly produced for use in exposed applications.

**Classes of milled pockets**

Class "A" - bottom and sides machined flat and square to each other and to dimensions. Class "B" - bottom machined flat. Sides need not be flat or square. Class "C" - strictly clearance. Loose tolerance on dimensions and finish of bottom and sides.

**Clearance**

The space, per side, between the punch and die. This space is also called breakage on trim and/or pierce dies. It is also the space between any two details to avoid interference.

**Clinch die**

See nutter die.

**Clinch nut die**

See nutter die.

**Clock spring material**

Alloy steel available in a pre-hardened condition between RC 45 and 52.

**Clock spring steel**

This steel product is manufactured and processed with great and extreme care exercised in each step of its production. Manufactured from carbon range of .90/1.03 with Rockwell range C 48/51. Clock spring quality has been ground and polished with edges dressed. It is usually supplied dark blue in color and has a wide range of uses, such as coiled and flat mechanical springs, ignition vibrator springs, springs for timing devices, springs for the electric and electronic fields, steel tapes, rules, etc.

**Clock spring strip**

Clock spring steel made available in a strip form.

**Closed-die**

A tool that creates a work-shape-imposing orifice, cavity, or passageway.

**Closed hem**

See flattened hem.

**CNC**

Industry acronym for Computer Numerical Control. See NC.

**CNC punch press**

Machine supplying compression force for reshaping materials and being controlled by a computer numerical control device.

**CNC turret press**

Automatic punch press indexing the material and selecting the intended tool out of the rotary tool holding device (turret) totally by computer control for piercing, blanking and forming workpieces as Programmed.

[top](#) [A](#)**Coat**

The paint, varnish or lacquer applied to a surface in a single application (one layer) to form a properly distributed film when dry.

**Coating**

The process of applying a coat to a metal surface.

**Coating system**

A system of applying a number of coats separately, in a predetermined order, at suitable intervals to allow for drying or curing.

**Coating weight**

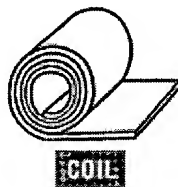
In the Sheet Mill, the amount of zinc on a galvanized sheet measured in ounces per square foot.

**Co-engineering**

Process in which the customer and the supplier review and modify a design to simplify manufacturability of a part.

**Coil**

A length of steel wound into roll-form.

**Coil breaks**

Creases, ridges, or marks appearing in sheets as parallel lines transverse to the direction of rolling and generally extending across the width of the sheet. Coil breaks are usually caused by improper coiling or leveling. They are also referred to as crossbreaks.

**Coil set**

A curvature of the strip in the lengthwise sense, parallel to the direction in which the strip was rolled or uncoiled.

**Coils**

Coiled flat sheet or strip metal that is usually in one continuous piece or length.

**Coin straightening**

A combination coining and straightening operation performed in special cavity dies designed to impart a specific amount of working in specified areas of a forging to relieve the stresses developed during heat treatment.

**Coining**

A compressive metal flowing action. A closed-die squeezing operation in which all surfaces of a workpiece are confined or restrained, resulting in a well-defined imprint of the die on the work. A restriking operation used to sharpen or change an existing radius or profile.

**Cold developing**

The initial development of a blank or part on paper or in wax during the designing of a die.

**Cold forming**

See cold working.

**Cold heading**

The process of upsetting the ends of a bar, wires, or tube stock while cold.

**Cold rolled**

A metal finishing process that subjects strip or sheet steel to a cold-reduction mill. Steel that has been subjected to the cold rolling process is considerably thinner and stronger than hot-rolled sheet. See cold rolled sheet and cold rolled steel.

**Cold rolled sheet**

A mill product produced from a hot-rolled pickled coil that has been given substantial cold reduction at room temperature. The usual end product is characterized by improved surface, greater uniformity in thickness, and improved mechanical properties as compared with hot-rolled sheet. A product manufactured from hot rolled descaled (pickled) coils by cold reducing to the desired thickness, generally followed by annealing and temper rolling. If the sheet is not annealed after cold reduction it is known as full hard.

**Cold rolled steel**

Steel that was reduced to final thickness in the cold state by a rolling mill that creates a smooth surface with slight skin hardness.

**Cold rolling**

Rolling metal at a temperature below the softening point of the metal to create strain hardening (work-hardening). Same as cold reduction, except that the working method is limited to rolling. Cold rolling changes the mechanical properties of strip and produces certain useful combinations of hardness, strength, stiffness, ductility and other characteristics known as tempers. Term applied to the operation of passing unheated metal through rolls for the purpose of reducing its gauge.

**Cold rolling mill**

A mill that reduces the cross sectional area of the metal by rolling at approximately room temperature.

**Cold weld**

Defective weld due to improper contact or inadequate heat during welding.

**Cold worked**

Material hardened naturally through forming at ambient temperatures.

**Cold working**

The plastic deformation of metal under conditions of temperature and strain rate that induce strain hardening. Usually, but not necessarily, conducted at room temperature. Also referred to as cold forming or cold forging. Contrast with hot working.

[top](#) ▲**Collapsible tool (segmented)**

A mold having a removable center core which keeps the perimeter pieces in place during spinning.

**Column press**

A four post single slide press.

**Combination die**

See compound die.

**Combined drill and countersink**

See center drill.

**Commercial finish**

See finishes.

**Commercial tolerance**

The range of difference that a product's specifications can deviate from the ordered specifications and still meet the industry accepted ranges as defined by ASTM Standards.

**Commercial grade**

Standard materials commonly available through supply houses.

**Composite forming**

Composite forming methods vary depending on the form of the fibers used. Chopped fibers are mixed with resin and shaped by polymer molding techniques; resin-impregnated mats of fibers are laid in a mold or pressed together and then allowed to cure; and continuous fibers coated with resin are wound on a mandrel to make spherical, cylindrical and other shapes.

**Compound die**

Tool used to pierce, form and blank a part at the same time, with one stroke of the press.

**Compressive strength**

The maximum compressive stress a material is capable of developing. With a brittle material that fails in compression by fracturing, the compressive strength has a definite value. In the case of ductile, malleable, or semi-viscous materials (which do not fail in compression by a shattering fracture), the value obtained for compressive strength is an arbitrary value dependent on the degree of distortion that is regarded as effective failure of the material. See ductility, malleability.

**Compressive stress**

A stress that causes an elastic body to deform (shorten) in the direction of the applied load. Contrast with tensile stress.

**Concave perimeter contour**

Curvature of the peripheral edge viewed from outside of the part.

**Concave surface contour**

Curvature viewed from outside of the material. See O.S.M.

**Concealed Head Fastener**

A fastener installed in a blind hole.

**Concentricity**

Dimensional relationship of 2 or more items sharing a common center line.

**Conditional match**

Perceived identity of color exhibited by a pair of colors, each with different spectral distribution curves. Also called Metameric match.

**Construction hole**

A hole in which the center line is used to dimension other

holes or surfaces. Sometimes referred to as a point of origin or coordinating hole.

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### **Continuous weld**

Continuously welding one coil to another at the entry end and splitting off coils of a specific weight at delivery end.

### **Contour forming**

See roll forming, stretch forming, tangent bending.

### **Contouring**

Machining surface shape on die members. Also called kellering.

### **Conventional draw die**

See draw die.

### **Convex perimeter contour**

The curvature of the peripheral edge viewed from outside of the part.

### **Convex surface contour**

The curvature viewed from outside of the material. See O.S.M.

### **Cookie cutter die**

A die employing a thin strip of steel formed to the outline of a part and a flat metal plate or block of wood for the punch. A cookie cutter die is used to cut non-metallic material, soft metals, and low run prototype sheet metal parts. See steel rule die.

### **Coordinate measuring machine (CMM)**

A machine for measuring three dimensional (X, Y, Z) coordinates on a component for inspection or geometry description purposes. The basic CMM system is comprised of four components, the machine itself, the probing system, the computer system and the measuring software.

### **Coordinating hole**

See construction hole.

### **Co-planar**

Having all elements, features, Dimensions or functions existing in one geometric plane.

### **Corn cob**

A milling cutter with serrated flutes or teeth. See roughing cutter.

### **Corner**

Three surfaces meeting at one point.

**Corner radius**

Outside radius.

**Corrective leveling**

Capability of a leveling machine to remove or reduce shape defects across the strip, coil, or sheet, in addition to flattening lengthwise curvatures.

**Corrugated**

Metal that has been formed using the corrugating process. As a defect, material with alternate ridges and furrows or a series of deep short waves.

**Corrugating**

The forming of sheet metal into a series of straight, parallel alternate ridges and grooves with a rolling mill equipped with matched roller dies or a press brake equipped with specially shaped punch and die.

**Corrugations**

Transverse ripples caused by a variation in strip shape during hot or cold reduction.

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**Counterbalance**

See slide counterbalance.

**Counterbalance pressure**

See slide counterbalance pressure.

**Counterbore**

A rotary, pilot guided, end-cutting tool, having one or more cutting lips and usually having straight or helical flutes.

**Counterboring**

Enlarging a hole to a limited depth producing a flat bottom in the enlargement. A machining or coining operation to generate a cylindrical flat-bottomed hole.

**Countersink**

A funnel shaped enlargement at the outer end of a drilled hole having an 82° included angle to allow the head of a screw to be flush with or below the surface. Also, a bit or drill for making a countersunk hole.

**Countersinking**

Machining or coining operation to generate a conical angle on a hole.

**Cracked edges**

Discontinuity or cracked condition on the edge of the strip.

**Crank press**

A mechanical press whose slides are actuated by a crankshaft.

**Cratering**

A coating defect consisting of small, apparently uncoated, spots of coated plate consisting of a very thin film of coating that has been contaminated by oil, silicone, or other foreign matter. Eyeholing is similar to cratering, but with metal exposure in the crater.

**Creep**

A term used in a hemming operation for the amount the part reduces in size along the flange radius when forming from a 90° flange to a full fold or hem.

**Crimping**

The forming of relatively small corrugations in order to set down and lock a seam, to create an arc in a strip of metal, or to reduce an existing arc or diameter. See also corrugating.

**Crossbow**

A curvature across the width of the strip at a 90° angle to the direction in which the strip has been rolled or uncoiled.

**Crossbreaks**

See coil breaks.

**Cross-over**

The physical area of a trim steel that overlaps the top of another trim steel, such as the area of an upper trim steel that is notched to go over the top of a lower scrap cutter. The distance between the two steels in this area, when die is closed, should be at least twice stock thickness.

**Crown**

The upper part (head) of a press frame. On hydraulic presses, the crown usually contains the cylinder; on mechanical presses, the crown contains the drive mechanism. A shape (crown) ground into a flat roll to ensure flatness of cold rolled sheet (and hot) and strip.

**Cumulative tolerance**

Progressive accumulation of tolerances resulting from multiple operations or assembly of multiple parts.

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**Cup**

A sheet metal part that is the product of the first drawing operation. Also, any cylindrical part or shell closed at one end.

### **Cup fracture (cup-and-cone fracture)**

A mixed-mode fracture, often seen in tensile test specimens of a ductile material, in which the central portion undergoes plane-strain fracture and the surrounding region undergoes plane-stress fracture. One of the mating fracture surfaces looks like a miniature cup; it has a central depressed flat-face region surrounded by a shear lip. The other fracture surface looks like a miniature truncated cone.

### **Cupping**

The first step in deep drawing.

### **Cupping test**

A mechanical test used to determine the ductility and stretching properties of sheet metal. It consists of measuring the maximum part depth that can be formed before fracture. The test is typically carried out by stretching the test piece clamped at its edges into a circular die using a punch with a hemispherical end. See also cup fracture and Olsen ductility test.

### **Curling**

The act of forming an edge of circular cross section along a sheet, workpiece, or at the end of a shell or tube.

### **Cushion pins**

Metal pins used in conjunction with a die cushion to transfer pressure from the cushion to the bottom of a die pad. They are also called air pins, cushion pins, pressure pins, and transfer pins.

### **Cut**

To separate any portion of a workpiece from any other portion of the same workpiece by a step of machining (e.g., grinding, drilling, boring, milling, planing), severing (e.g., breaking, sawing, slicing, shearing), or by intrusion of a sharp-edged or pointed tool without removal of material (e.g., stabbing, splitting, intrusive punching). See pierce.

### **Cut and carry method**

A method in which the part under fabrication is not entirely detached from the strip or is pushed back into the strip for transporting to a succeeding station in a progressive die.

### **Cut edge**

The normal edge that results from the shearing, slitting or trimming of a mill edge.

### **Cutoff**

A pair of blades positioned in dies or equipment (or a section

of the die milled to produce the same effect as inserted blades) used to separate the forging from the bar after forging operations are completed. Used only when forgings are produced from relatively long bars instead of from individual, precut multiples or blanks. See blank.

### **Cutting**

See cut.

### **Cutting land**

See die life.

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